Frontenac, Lennox & Addington
Science Fair

Expo-sciences de Frontenac, Lennox & Addington

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Prefair Report

4401   Darien Shinniman, Gracey Vanberkel

Div/Cat   <u>Human Health / Senior</u>

Title: <u>Zap That Zit</u>

Summary: Have you ever wondered where acne comes from and how you can treat it? One major cause of acne is the colonization and infection of clogged pores with bacteria. In our science project, we will test different acne medications and treatments to determine their effectiveness at killing bacteria. Our project consists of testing newly marketed acne medications and treatments, as well as some older treatments too. This is to determine which acne medication is the most effective in the treatment and prevention of acne.

We believe that the newly marketed medications and treatments will be more effective than the older treatments in the prevention and treatment of acne. This is because Dermatologists have put in extensive research towards bettering our skin. We will prove our hypothesis by using bacteria found on our facial region and testing it against medications and other treatments for acne.

Many people, but more specifically youth entering puberty, have been impacted by the affects of acne. These affects include; lower self-esteem, self-confidence, and self-worth. By doing a project that can influence our peers, we can make a difference in the way they see themselves; thus, promoting our interest in this intriguing topic for our science fair project.

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Prefair Report

4402   **Shylah Hart, Olivia Williams**

Div/Cat   **Human Health / Senior**

Title: **The Truth Behind the Red Blood Cell**

Summary: This is an experiment that is currently in process. This experiment is conducted to allow us to see and better understand how a red blood cell reacts with different solutions of chloride (Sodium chloride, lithium chloride, copper chloride). Using a microscope camera, we are going to test and record how the cell works with these solutions. We will obtain the blood samples using animal blood. The solutions, which will be made in a classroom, will be injected into the red blood cells and then analyzed. Furthermore, we are investigating to see if the red blood cell is just plasma or if it has a membrane, and if so what types of ion channels open within the membrane of the red blood cell. Once we see the reactions that occur with the red blood cell, we will compare the results with the periodic table and try and discover as to why those solution did or did not react the way in which we thought. We think that this experiment and it's finding could be useful for medical reasons, as it could determine which solutions could be safely used in the human body. As well, as this experiment will be able to allow us to understand more about the red blood cell.

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Prefair Report

4405   **Ria Raut, Zarin Tasneem**

Div/Cat   <u>**Human Health / Senior**</u>

Title: <u>**Cultivating Creativity**</u>

Summary: Our project looks at the brain and creativity - specifically, how to increase creative capacities. We want to see how people make connections and how they create new ideas. The stronger the connections made between seemingly random and abstract ideas, the more creative a person is. We found that generally, creativity is cultivated when one steps out of their comfort zone and is exposed to multiple thought processes and experiences.

We conducted a study to test if we could increase our creativity, by first assessing participants original creativity via a RAT test (Remote Association Test). Then we gave them a series of activities that we believed would increase their creativity, activities that the participants would be unfamiliar with (For example, we asked participants to expose themselves to music from different cultures and absorb their mindset). These assigned activities were individualized, and based on what each participant told us about their personality.
Over the next few weeks, we asked the participants to write more RAT tests to see if their score had improved - essentially, to see if their creativity had increased.

We hope our research will help others who are looking to try something different or create something new, or those who are not confident in their creative ability and want to be more innovative and imaginative. The ability to augment creativity can be beneficial to everyone and every field to some degree, from artists to scientists and researchers.

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Prefair Report

4406   **Nisha Gill**

Div/Cat   <u>**Human Health / Senior**</u>

Title: <u>**Fe-getable**</u>

Summary: The purpose of this experiment was to investigate the iron content of leafy, green vegetables. Based on background research, it was hypothesized that the greener the vegetable, the higher its iron content.

First, a Beer's Law graph was established, using five different solutions with known concentrations of iron (III) nitrate. The five concentrations used were 0.0000 mol/L, 0.00025 mol/L, 0.00050 mol/L, 0.00075 mol/L and 0.001 mol/L. Once the solutions were prepared, 2.5 mL of a 0.1 mol/L potassium thiocyanate was added to each, which resulted in a clear to orange colour change, depending on the concentration of iron. The higher the concentration of iron, the brighter the orange colour produced. The highest concentration solution was then transferred to a cuvette and analyzed in a spectrophotometer. The spectrophotometer was set to a wavelength of 428 nm, and the absorbance of the sample was recorded. This process was repeated twice more for the highest concentration solution, and then for the other four samples. The data gathered was then used to create a Beer's Law graph, to help determine the iron concentration in vegetables in the next part of the process.

The app Pixel Grab was used to determine the greenness of the five vegetable samples: chard, iceberg lettuce, kale, romaine lettuce and spinach. Each sample was weighted, and its wet mass recorded. The samples were then incinerated, one by one, in a porcelain crucible over top of a Bunsen burner. Enough of each vegetable was incinerated so that there was 0.70g of ash for each. Once the ash was cool, it was crushed with a mortar and pestle, divided into even thirds (0.23g) and then each of third was dissolved into 10 mL of 2.0 mol/L HCl. Then 10 mL of distilled water was added to each third. The first of the third solutions was filtered in into a Erlenmeyer flask, using a funnel and filter paper. 2.5 mL of the 0.1 mol/L potassium thiocyanate solution was added to the solution in the Erlenmeyer flask, to produce a colour change. The solution was then transferred to a cuvette and placed in the spectrophotometer. The spectrophotometer was again set to a wavelength of 458 nm and the absorbance of the sample was recorded. This process was repeated twice more for the first vegetable sample, and then for the other four samples.

The data collected is still being analyzed.

4407   **Jessica Wang**

Div/Cat   **Human Health / Senior**

Title: **How does Lysol concentration affect bacteria growth?**

Summary: My experiment tests how varying levels of Lysol concentration changes the effectiveness of the antimicrobial cleaning solution when used to prevent bacterial growth. In order to conduct this experiment, six different concentrations of Lysol solutions were tested (at 0%, 20%, 40%, 60%, 80%, and 100% concentration). The effectiveness of the solution was measured by the area of the zone of inhibition that formed when paper chads dipped in the solutions were placed on agar plates that were coated in bacteria. The larger the zone of inhibition, the more effective the Lysol solution was at preventing bacteria growth. It was hypothesized that as the concentration of the Lysol solution increases, there will be a larger zone of inhibition surrounding the paper chads placed on a bacterial plate. This proves that the Lysol will be more effective in killing bacteria as the concentration increases. After the experiment was conducted and the data was collected, the data was analyzed using the Pearson correlation coefficient statistical test and the r squared value was calculated. This provided insight in how accurate the results were, as the higher the correlation coefficient and r squared value, the more accurate the conclusion will be. This provided the information to be able to prove or disprove the null hypothesis.

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Prefair Report

4408   **Aidan Fraser**

Div/Cat   **Human Health / Senior**

Title: **La reprogrammation cellulaire: une solution possible à la greffe d'organe**

Summary: Lors de la première décennie du 21e siècle, les scientifiques ont découvert une méthode permettant de transformer un type de cellule adulte en un autre type qui était complètement différent. Ceci fut une immense découverte dans le domaine de la médecine, leur permettant de prendre certaines cellules dont un individu avait en surplus, (comme les cellules de la peau ou du sang) et de les transformer en un type de cellule qu'ils nécessitent, comme des cellules qui composent des organes comme le coeur ou le foie. Lors de cette étude, ce processus de reprogrammation cellulaire est exploré en profondeur dans le but de comprendre comment cette technique pourrait éventuellement être utilisée dans le but de réparer ou de reproduire des organes complets. Dans ce projet, il se fait une étude de facteurs de transcription et leur importance dans le développement et la différenciation entre les organes. Plus spécifiquement, les facteurs de transcription seront étudié dans le but de reproduire un pancréas humain. En utilisant l'application AmaZonia!, les facteurs de transcription importants aux pancréas seront notés et évalués pour déterminer ceux qui sont les plus essentiels au développement de cet organe. Les effets de cette méthode de reprogrammation cellulaire seront aussi étudiés pour déterminer l'efficacité de cette méthode en tant que traitement médicinal.

Le pancréas est un organe très complexe qui est essentiel à la survie. En effet, il a deux fonctions principales: exocrine et endocrine. Ceci le rend un organe très compliqué. Il existe plusieurs troubles reliés au pancréas pour lesquels il n'existe aucun remède - notamment le diabète. Pour d'autres troubles comme des réactions à l'insuline et des endommagements sévères aux reins, un transplant de pancréas est recommandé. En effet, le pancréas est un des organes les plus transplantés après les reins, le foie, le coeur et les poumons. Bien qu'il y a eu plusieurs avancements technologiques envers la transplantation d'organe, celle-ci peut engendrer plusieurs conséquences, allant même à la réjection de l'organe nouvellement transplanté par le système immunitaire. Ceci étant dit, une méthode de reprogrammation cellulaire comme celle étudié dans cette expérience permettrait d'éviter ces risques, en utilisant simplement les cellules de l'individu même.

Les résultats de cette étude seront dévoilé à la foire même. Ce sujet, à la fois intriguant et courant, discute un nouveau traitement qui pourrait mettre fin à la greffe d'organe connu aujourd'hui.

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Prefair Report

4409 **Kaamraan Islam**

Div/Cat <u>**Human Health / Senior**</u>

Title: <u>**Mitigation of Secondary Malignancies while Maintaining Radiation Therapy Lethality in Breast Cancer**</u>

Summary: Invasive ductile carcinoma (IDC) is a type of breast cancer that affects 12.4% of women (USA). IDC by definition has broken through the milk duct of the breast and invaded the surrounding breast parenchyma. The pathogenesis stems from deoxyribose nucleic acid (DNA) damage that is often influenced by estrogen exposure. Prognostic factors include tumour size and the number of affected lymph nodes. Surgery is performed to remove the tumour and affected lymph nodes; commonly followed by external beam radiation therapy (EBRT) to reduce risk of local recurrence.

The goal of EBRT is to maximize the dose of radiation to kill cancerous cells while minimizing damage to healthy tissue. Deposition of energy from ionizing radiation causes single and double DNA strand breaks. These strand breaks can lead to gene mutations and also cause damage to DNA repairing proteins which can contribute to radiation induced secondary malignancies (RISM). Approximately 17-19% of patients develop RISM. A study conducted in 2016 on women with breast cancer concluded radiation therapy increases the risk of developing secondary malignancies by 93% compared to treatment without it.

This study modelled radiation oncology therapy for women with breast cancer. The purpose of this study was to determine the effects of in-vitro delivery of antimutagenic agents to the DNA of IDC and surrounding cells post radiation. The antimutagenic agents chlorophyllin, resveratrol and melatonin were used in an attempt to mitigate the formation of secondary malignancies. Saccharomyces cerevisiae, HA2 Strain, a, ade2 were used to model IDC cells and exposure to ultraviolet type B (UV-B) radiation modelled EBRT.

The addition of chlorophyllin to Saccharomyces cerevisiae cells prior to radiation is predicted to best mitigate the occurrence of secondary malignancies while damaging the DNA of cancerous cells post radiation. This is because chlorophyllin reduces DNA strand breakage caused by oxygen free radicals and research shows the structure of its molecule allows it to mitigate proliferation of cancer cells by binding to their DNA adducts.

Genetically identical Saccharomyces cerevisiae was spread onto 20 yeast extract-dextrose (YED) plates. All plates received 5 hours of UV-B radiation to create a mix of mutated cells (white pigment) to model IDC cells and non-mutated cells (red pigment) to model normal cells. 5 control YED plates were exposed to a lethal dose of UV-B radiation to simulate ionizing radiation waves. The same quantity of each antimutagenic agent was spread onto 5 YED plates. These plates were also exposed to the same lethal dose of UV-B radiation to simulate ionizing radiation waves. The number of regular colonies that became mutated (secondary malignancies) and mutated colonies killed were recorded post simulated ionization radiation waves. Results will be available at the fair.

This study could provide insight into developing a novel method to mitigate the pathogenesis of secondary malignancies while maintaining lethality of EBRT to IDC cells. A drug could be developed that could be administered to patients while receiving EBRT to protect normal cells from DNA damage or taken as oral supplements to protect cells from random genetic mutations.

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Prefair Report

4410   **Zhen Wang**

Div/Cat   **Human Health / Senior**

Title: **Oxidative stress? Not for these guys!**

Summary: This project aims to answer the question: "How does exposure to different concentrations of oxidizing agent affect the resistance of oxidative stress? This was tested by extracting and isolating a bacteria sample from the environment, and then mixing the bacteria with an oxidizing agent at various concentrations. The testing consists of culturing the bacteria on an agar plate, dotted with paper chads soaked with the oxidizing agent. The paper chads gradually release the oxidizer, which diffuses through the agar around it. The diffusion will result in a gradient for the oxidizer, with the area closest to the chad containing the highest concentration, decreasing in a squared relationship moving further from the chad. If the bacteria is not resistant to the oxidizer, its growth will be inhibited. Thus, the resistance of bacteria to the oxidizer can be determined by the area around the chad with no bacterial colonies, called a zone of inhibition. The smaller the zone the more resistant the bacteria and vice versa. The implications of this study are twofold. Firstly, investigating the development of oxidative resistance in bacteria from added stress can shed light on how organisms adapt to their environment. This has the potential of investigating how humans react to oxidative stress and may yield a way for humans to alleviate our own oxidative stress, a contributor to aging, cancer and heart disease. In addition, it allows for an investigation into the effectiveness of oxidative disinfectants, such as hydrogen peroxide and bleach, after repeated use.

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Prefair Report

4411　　**Gary Kong**

Div/Cat　　<u>**Human Health / Senior**</u>

Title:　　<u>**Remember to Breathe**</u>

Summary:　In response to stressful events, the amygdala (in charge of emotional processing) sends a distress signal to the hypothalamus, which in turn sends signals through the autonomic nerves to the adrenal glands. The adrenal glands respond to these signals by pumping epinephrine into the bloodstream. Epinephrine triggers many effects in the body to optimize the body's performance, including an increased heart rate, increased rate of breathing and the opening of small airways in the lungs. ("Understanding the stress response," n.d.) These reactions result in an increased rate of anaerobic cellular respiration to supply the body energy to respond to the stress. Due to the increased rate of breathing, someone who is overstimulated by adrenaline may experience hyperventilation and possibly faint. A repeated increased rate of breathing may result in bad breathing patterns and hyperventilation syndrome (HVS). (Breathing, n.d.) I chose to analyse the specific change in breathing rates when humans are exposed to a minor stressor to find if there was a statistically significant difference between the breathing rate and volume when exposed to minor stressors versus a resting breathing rate and volume. As chronic hyperventilation results in hyperventilation disorder, a chronic exposure to minor stress and hyperventilation could result in hyperventilation disorder and other breathing related difficulties.

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Prefair Report

4412   **Alex Chan**

Div/Cat   **Human Health / Senior**

Title: **Shedding Light on Sunscreens**

Summary: Effectiveness of Sunscreen Protection against Cancer

The number of people diagnosed with skin cancer in Canada has risen steadily over the past 30 years. In 2016, about 6,800 Canadians were diagnosed with melanoma and 1,200 will die from the disease. Skin cancer is mainly caused by ultraviolet (UV) radiation from sunlight and tanning lamps. The objective of this project is to investigate the effectiveness of different sunscreens' active ingredients, namely titanium dioxide, salicylates, and benzophenone derivatives.

A species of yeast - Saccharomyces cerevisiae (i.e. Baker's yeast) - was grown in Petri dishes due to the similarity of its DNA with human DNA. Sunscreen was then applied to the lid of the Petri dishes and the area coverage of the yeast cells was measured after 75 minutes of UV exposure. To compare the effectiveness of different sunscreens' active ingredients, a control group was also grown with no UV exposure. The percentage decrease between the samples that had UV exposure and the control group was then compared. It was found that the titanium dioxide-based sunscreen was the most effective, which corresponded with previous research on the absorbance spectrum of different common active ingredients used in sunscreens today.

However, many chemical ingredients used in sunscreens are known to be harmful to our bodies. For example, homosalate impacts the body's hormones, particularly the estrogen system, and benzophenone is listed by the California Environmental Protection Agency as a possible human carcinogen. Consequently, natural sunscreens using oils made from plants will also be investigated. Previous research has shown that some natural sunscreens are as effective as commercial ones without their potential health risks.

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Prefair Report

4413   **Leanna Havreluck**

Div/Cat   <u>**Human Health / Senior**</u>

Title: <u>**Teeth and Tea: An Experiment on Acidity**</u>

Summary: This experiment studies the effect of the acidity of different types of teas -- black, white, green and oolong -- on an egg shell's mass. Each tea has a different oxidation level and thus a different acidity. Black tea is fully oxidized and has a pH of 4.9-5.5. Oolong undergoes partial oxidation and is therefore less acidic, depending on how long it steeps and the brand it can range from 5.9-8.2. Green oxidizes for a very short period of time, and therefore has the highest estimated pH, 6.9-9.7. White tea is not oxidized at all, but uses the younger part of the plant and hence is just as acidic as black tea depending on the steeping time (5.9-8.2). It was hypothesized that the acidic substance would slowly degrade the egg shell's mass over time. The most acidic substances were the white tea and black tea, hence it was hypothesized that the white or black tea would degrade the egg shell the most, green has the lowest acidity so it would degrade the egg shell the least. The null hypothesis stated that there would be no mass loss of the egg shell. The independent variable was the type of tea and hence acidity of the solution. The dependent variable was the mass of the egg shell. Controlled was the temperature of the solution, the volume of the solution and the steeping time of the tea. A controlled experiment was performed with just water to act as a verifier for the null hypothesis. The egg shells were broken, the membranes removed before, and massed before being placed in a solution of brewed tea and were measured every 10 minutes for 30 minutes overall. The results of this experiment are pending. The white tea was the most acidic and oolong the least. The experiment models the effect of drinking tea on teeth and the potential enamel damage from long term tea-drinking despite being used as an alternative to coffee. To a lesser extent the experiment also models the potential effect of ocean acidification.

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Prefair Report

4414   **Fatima Sajid**

Div/Cat   **Human Health / Senior**

Title: **The Effect of Age on Colour Perception**

Summary: The purpose of this experiment was to investigate the research question: Is hue discrimination, as measured by an electronic application, affected by an increase in age? Based on background research, it was hypothesized that the hue discrimination score does depend on the age; the older the age range, the higher the hue discrimination score. To measure the hue discrimination score: First, the consent forms were handed out to each individual and they were instructed to read it and if they agree with the ethical conducts stated, they are to sign beforehand. After they have signed the form, they are to be informed about the nature of the study (i.e. instructions, 2-minute timer with warnings at specific marks). Each participant was recorded anonymously; in this experiment, subjects were labeled by participant number. The laptop was placed in front of the participant and they were told they cannot move the last and first hues but must arrange the hues in order depending on the first and last hues. They must also complete each band of hues (4 to complete). Each participant is given a 2-minute mark of the time limit with the trial starting by 'go' and ending with 'stop'. In conclusion, our alternate hypothesis and null hypothesis were both supported equally by evidence and analysis/other observations. It was also proven by analysis of the participant hue discrimination graphs, that blue was the color participants had the most difficulty with.

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Prefair Report

4415   **Irene Castellano Gomez**

Div/Cat   <u>**Human Health / Senior**</u>

Title: <u>**The effect of citrus drinks on the absorption of iron pills**</u>

Summary: Iron deficiency is one of the most common diseases in women that causes anemia. Hence, most of the people are required to take iron supplements or iron pills with their meals to increase the level of iron in their blood. Commonly, although this depends on the type of iron pills, professionals suggest ingesting the iron pills with citrus drinks, usually orange juice. After doing some research, I found that iron pills absorb at a better rate and much effectively when they are mixed with Vitamin C (ascorbic acid). This process could happen naturally in our body if we consume food with both Vitamin C and iron, like oranges and spinaches respectively. Therefore, my project explored the effect of different citrus juices on the absorption. To do so, I created a simulation of the stomach acid on different beakers where I added a different type of citrus juice and an iron pill on each one. After a specific time, I massed the different pills in order to calculate how much was dissolved in the stomach acid and juice concentration and therefore it would be theoretically absorbed in the human body. Results are still pending. This investigation will help people to be aware of the different types of juices that can be ingested in order to maximize the absorption of iron in our body.

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Prefair Report

4416   **Dhruv Patel**

Div/Cat   <u>**Human Health / Senior**</u>

Title: <u>**A Novel Therapy to Diagnose Glioblastoma Through Convolutional Neural Networks**</u>

Summary: Despite great advances in the field of oncology, glioblastoma remains the most common and aggressive brain cancer, with minimal expression of a diagnosing target, and a grim prognosis. A median survival length of a mere 11-15 months couples with one of the lowest survival rates of all cancers, at approximately 4%. Although the current cause of glioblastoma remains to be discovered, the disease etiology is centered around a genetic background. Current diagnosis techniques are limited to MRI imaging after tumor formation has occurred, which increases the impact of the disease before detection.

The purpose of my project is to analyze whether a convolutional neural network can be used as a diagnosis tool for glioblastoma, and how this can be implemented in the prognostic treatment of glioblastoma patients. This project focuses on two main research pathways: first, providing insight into therapeutic target through gene expression analysis in various cancer cases (Kaplan-Meier analysis). Additionally, the utilization of deep learning techniques to train itself following a technique to recognize tumors in biological scans of glioblastoma can be the base for drug development technologies. Various cancer imaging datasets were utilized in the creation of this machine learning model, and mRNA expression levels of various genes were also analyzed during this project. Variables involved in this project included the training success during testing of the neural network and the outliers in mRNA expression in unique glioblastoma cases.

As a result of the low survival rate, treatment planning and improving prognostics are key stages to improve the quality of life of glioblastoma patients. Simultaneously, detection models have made great progress with non-small cell lung cancer and Alzheimer's in the medical diagnostics industry, while the current conventional detection of brain tumors involves human inspection of radiological imagery for tissue abnormalities. My project aims to utilize convolutional neural networks (CNN) on nuclear magnetic resonance (NMR) imaging for the same purpose. In this work, an efficient MRI image segmentation using a CNN is used to cluster abnormal portions from biomedical images. Work was primarily split into three categories: data extraction and preprocessing of imagery, convolutional neural network training, and the machine learning classification period.

The automation of early-stage tumor detection drastically reduces the workload of radiologists, aids with patient outcomes through earlier treatment, and may provide insight into the characteristics of high-grade glioblastomas, while creating predictions on tumor growth and progression in patients. NMR Imaging and machine learning algorithms look promising regarding their potential applications in the medical field, particularly in the field of medical diagnoses and drug development.

The results, conclusions, and further applications will be displayed on board at the FLASF event.

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Prefair Report

4417   **Ariel Burgess**

Div/Cat   **Human Health / Senior**

Title: **Can Untrained Canines Detect Chronic Illness in Humans**

Summary: One at a time, a set of dogs will be presented with unwashed, uncontaminated clothing of people suffering from chronic illness - including but not limited to Parkinsons, Cancer, Anxiety - mixed with unwashed clothes of those in perfect health. Because the dogs are not trained service or alert dogs, this may have to be repeated several times so the observer can see if or what their "tag" response is. (A tag is the dogs alert to stimuli it is looking for - drug dogs sit for example). Once done, the observer will collect the data and form statistics, based on the level of accuracy the dogs had in tagging the clothes of those who are ill. The dogs will be of all different breeds and sizes - this will also be taken into account. Because the animals cannot be on school property, the majority of the project will be video taped and then edited into a comfortably sized but still accurate video. Photos will also be taken, along with some relevant facts about the animals. Through this project I hope to gain insight into how canines smell works, and whether or not they could be used effectively as early detectors of chronic illness or disease that may otherwise go unnoticed until much later.